CONSTRUCTION QUALITY ASSURANCE PLAN

R6 CCR LANDFILL
PLANT YATES
COWETA COUNTY, GEORGIA

FOR

Georgia Power

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TABLE OF CONTENTS

1. GENERAL 3
2. CCR EXCAVATION 4
3. GRADING 4
3.1 Subgrades 4
3.2 Conformance Testing 5
4. PLACEMENT OF EXCAVATED CCR INTO THE R6 LANDFILL (PHASE 1 AND 2 ONLY) 5
5. RECORD AS-BUILT DRAWINGS 6
6. STRUCTURAL EARTH FILL 6
6.1 Material 6
6.2 Lift Thickness and Compaction Requirements 7
4.3 Observations 7
4.4 Testing 7
7. LOW PERMEABILITY SOIL LAYER FOR FINAL COVER SYSTEM 8
7.1 Material 8
7.2 Pre-Construction Material Evaluation 9
7.3 Construction 9
7.4 Performance Testing 10
8. GEOMEMBRANE LINER, ENGINEERED TURF & SAND BALLAST – CLOSURETURF® COVER SYSTEM 11
8.1 Introduction 11
8.2 Manufacturing Plant Visit 12
8.3 Materials, Handling, and Storage 12
8.4 Manufacturer QC (MQC) Testing and Conformance (CQA) Testing 13
8.5 Anchor Trenches 14
8.6 Geomembrane Placement 14
8.7 Field Panel Seaming 15
8.8 Defects and Repairs 22
8.9 Geomembrane and Cap System Acceptance 22
8.10 Materials in Contact with the Geomembrane 23
9. GENERAL SITE WORK 28
9.1 Introduction 28
9.2 Conformance 28
10. CERTIFICATION 28

1. GENERAL

The R6 CCR Landfill closure construction is broken into 3 phases. Closure construction for Phase 1 and 2 which encompasses approximately 68 acres has been completed in accordance with the Solid Waste Handling Permit # 038-011D (LI). Due to multiple CCR unit closures near R6 and the need to accommodate shared stormwater infrastructure, the remaining 14 acres will be closed in Phase 3.

This Construction Quality Assurance (CQA) Plan describes the quality assurance activities that will be undertaken during the in-place closure of Phases 1, 2, and 3 of the R6 CCR Landfill. The purpose of this document is to define the scope, formal organization, and procedures necessary to perform quality assurance tasks such that the construction elements of the closure of the R6 CCR Landfill comply with the design as shown in this CQA Plan and Closure Plan.

Parties involved in the CQA program:

1. PURCHASER, OWNER, OPERATOR: Georgia Power Company (Georgia Power).

2. CONTRACTOR: The entity awarded the contract to furnish the materials and perform the work as described herein and as specified in the Closure Plan.

3. CONSTRUCTION SITE MANAGER (CSM): The on-site manager of the project or his designated representative. He is the authorized representative at the site for the Purchaser.

4. DESIGN ENGINEER: The company or companies hired by the owner/operator to furnish the design, drawings, plans, and specifications for the facility. The DESIGN ENGINEER will be a registered professional engineer licensed in Georgia.

5. CQA ENGINEER, CQA FIRM, and CQA INSPECTOR: Responsible for implementing the construction quality assurance requirements as stated in the project plans, technical specifications, this CQA Plan, and the project objectives; verifying basic data as reasonable and complete; outlining procedures to process data; developing statistical procedures for the analysis of test data; and preparing quality assurance memoranda and quality assurance reports. The CQA Engineer will report to Georgia Power. The CQA Engineer will be a registered professional engineer licensed in Georgia. Reference to the CQA Engineer, for the purpose of this document, will include the CQA Engineer and his/her designated representatives.

6. CQC ENGINEER/TECHNICIAN: Refer to the third party firm responsible for construction quality control monitoring, testing and documentation for all work performed during the construction at the facility. The CQC Engineer/technician will be a registered professional engineer and licensed in Georgia.

7. AS-BUILT SURVEYOR: Refers to a registered professional land surveyor, licensed in Georgia, responsible for conducting as-built certification surveys on the components identified in the CQA Plan.

2. CCR EXCAVATION

CCR removal refers to the process of verifying and documenting that CCR has been removed to residual soils from areas within the R6 permitted boundary and deposited in the Ash Management Area (AMA), which is permitted under separate cover. Specifically, CCR will be removed from along Dyer Road for groundwater monitoring purposes. In addition, a minimum six inches of soil will be removed below the verified CCR/soil interface and placed in the AMA. The CCR excavation and removal Procedures are described below:

Visual Verification of CCR Removal Procedure:

GPC engaged the services of a Construction Quality Assurance (CQA) firm to monitor and document CCR removal according to the following procedure:

1. A maximum 100 ft. x 100 ft. survey grid, approved by the CQA Engineer, will be established for the CCR removal area. Grid points will be assigned a unique alphanumeric label for reference and documentation of CCR removal.
2. CCR will be excavated until there was no visible CCR present.
3. CQA personnel will inspect the CCR/soil interface to confirm that all visible CCR was removed. Observations will be made with reference to the established and approved grid map. Observations will include, but were not limited to, taking photographs, and describing soil color utilizing the Munsell Soil Color Chart. Observations will be documented in field logs or reports.
4. The CCR/soil interface surface will be surveyed.
5. The excavation will continue to a minimum 6-inches depth below the CCR/soil interface to ensure CCR removal. Excavated soil will be disposed of in the AMA.
6. The bottom of excavation will be inspected by the CQA Engineer, surveyed and documented, as above, to confirm a minimum of 6-inch excavation below the CCR/soil interface.
7. The CQA Engineer will prepare a CCR Removal Verification Report documenting the results of the CCR removal.

3. GRADING

The CQC Engineer will observe and document all earthwork grading (excavation/fill placement) activities, test the compaction of in-situ materials and of structural fill. The CQA Engineer is responsible for certifying that the materials and construction of the earthworks are in accordance with the plans, technical specifications, and this CQA Plan.

3.1 Subgrades

During closure construction, conformance and performance testing of the subgrade soil materials will be performed by the CQC Engineer. The CQC Engineer will monitor and document proof-rolling of areas that are cut to achieve grade. Material placed to achieve grades indicated on the plans will be tested by the CQC Engineer in accordance with the test methods and frequencies listed herein to verify that the compacted fill materials used by the Contractor comply with this CQA Plan. Areas of proof-rolling or compacted fill that do not conform to this CQA Plan will be delineated and reported to the Contractor. The CQC Engineer will document that these areas are reworked by the Contractor and retested until passing results are achieved.

The review and approval of the As-Built Subgrade Elevation Contour Drawings, or pertinent areas thereof, shall be part of the Subgrade Acceptance. Subsequent work shall not proceed until the Subgrade Acceptance Certificate and the As-built Subgrade Elevation Contour Drawings (or pertinent areas thereof) have been reviewed, approved, and signed by the Contractor, CQC Inspector, CQA Engineer, and the Purchaser's Representative.

3.2 Conformance Testing

The CQC Engineer will observe and test the structural fill soils to confirm that they are uniform and meet or exceed the requirements of this CQA Plan. For soil materials obtained from on-site or off-site borrow areas, the CQC Engineer will perform visual inspections and conformance tests prior to the materials being used.

CQC personnel will observe structural fill materials to ensure they are free of deleterious materials, (e.g., roots, stumps, rocks, and large objects). When necessary, the Visual Manual procedure for the description and identification of soils will be conducted by the CQC Engineer in accordance with test method ASTM D2488.

Prior to receiving structural earth fill, the foundation area will be scarified by harrowing or other suitable means. Structural earth fill materials will be placed in uniform layers of eight inches, nominal thickness, loose measurement, for one foot beyond the full width of the fill on each side. The thickness of each layer will be kept uniform with the necessary grading equipment. Upon completion of compaction, the slopes will be cut back to the final slope. Particular care will be used to obtain the required compaction along the edges of the fill slopes.

All testing will be conducted in accordance with the CQA Plan. The field-testing methods used to evaluate the suitability of soils during their installation, will be performed by the CQC Engineer in accordance with current ASTM test procedures indicated in the table below.

4. PLACEMENT OF EXCAVATED CCR INTO THE R6 LANDFILL (PHASE 1 AND 2 ONLY)

CCR fill materials placed in the R6 Landfill to achieve final grades shall be placed in uniform layers of 12 inches, maximum nominal thickness, and loose measurement. The thickness of each layer shall be kept uniform with the necessary grading equipment. If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or as directed by the Purchaser's Representative, before the succeeding layer is placed. CCR fill and CCR impacted soils being placed in the R6 Landfill shall be compacted to a minimum of 95% of the relative maximum dry density as determined by the standard Proctor density test (ASTM D 698).

The moisture content of the CCR fill at the time of placement shall be within -5% and +2% of the optimum moisture obtained by standard Proctor density test. When moisture content is too low, the moisture content shall be adjusted to within the above limits prior to compaction. Moisture adjustment shall be achieved by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and harrowing of the layer shall be done after deposition, but before compaction.

If the moisture content is too high, the Contractor will be permitted to disk in place or stockpile and disk the CCR material to promote drying to bring it back within the allowable moisture range.

Field density and moisture content tests shall be performed daily in all types of material being placed. At a minimum, one in-place density test shall be performed for each lift for each day fill material is placed. For CCR fill, at least one field moisture content and density test shall be performed for every 1,000 cy of fill (one test per 8-inch compacted lift, per 40,000 SF) or more often if deemed necessary in the opinion of the Purchaser's Representative.

5. RECORD AS-BUILT DRAWINGS

Record As-built Elevation Contour Drawings (topographic maps) shall be made of the following components of the final cover system. All as-built elevation contour drawings shall be prepared on a grid established and approved by the CQA Engineer. Surface contours shall be based on survey shots at grid points and include shots taken at all grade breaks (e.g., drainage berms and drainage ditches). A minimum of six points (both crests, toe of slopes and slope midpoints) shall be obtained along the bottom of the flumes along each grid line. Drawings to be signed and sealed by a land surveyor registered to practice in the state of Georgia.

a) As-built Subgrade Elevation Contour Drawings of the subgrade for the Final Cover System.
b) As-built Elevation Contour Drawings of the top surface of the 18-inch compacted Infiltration Barrier Layer.
c) Final Grade – As-built Final Grade Elevation Contour Drawings with thickness of topsoil.
d) As-built drawings indicating geomembrane panel locations, panel identification numbers, geomembrane roll numbers for each panel, seam caps, destructive sample locations, and repair locations.
e) Thickness determinations of the HydroBinder^{TM} infill.
f) A record topographic survey will be performed to fully document the lateral and vertical extent of the developed area, drainage structures and drainage features.

All survey shots shall be “stacked” in order to properly verify the given layer’s thickness. The use of interpolation or other computer generated methods to achieve point stacking are not acceptable. Thickness determinations obtained at grid points on slopes shall be made normal to the slopes.

6. STRUCTURAL EARTH FILL

6.1 Material

Structural fill is soil material placed and compacted to achieve final grades. Structural fill will consist of on-site soils that meet the project specifications. Soils may be imported from off-site if needed. The structural fill will be constructed and compacted to meet the requirements outlined in this Section. Each structural fill material source will be approved in advance by the Engineer through the submittal process. Soil imported

from off-site and on-site soils from outside the CCR unit will be evaluated for conformance to the requirements listed in Table 4.2. The approximate 6-inch thick surficial soil layer will be capable of supporting vegetation and. At the Purchaser's request, the surficial soil layer shall be evaluated through agronomic testing and amended as necessary. The CQC Engineer/technician will monitor and document structural earth fill according to the following requirements.

6.2 Lift Thickness and Compaction Requirements

6.2.1 The CQC Engineer/technician will document and confirm that the structural fill is placed in accordance with the requirements shown in Table 4.1 of this section. Areas failing to meet the requirements in Table 4.1 below will be reworked, or removed and replaced by the Contractor and retested by the CQC Engineer.

6.2.2 The CQC Engineer will document and confirm that each lift is compacted prior to placement of succeeding lifts. The CQC Engineer will document and verify compaction in confined areas where mechanical equipment, suitable for small areas and capable of achieving the density requirements is used.

6.2.3 The CQC Engineer will document and confirm that lift compaction is performed with an appropriately heavy, properly ballasted, penetrating-foot or smooth-drum vibratory/non-vibratory compactor depending on the soil type.

Table 6.1 - Structural Fill Placement Criteria

Item	Required % Compaction Standard Proctor (ASTM D698)	Required % of Optimum Moisture, Standard Proctor (ASTM D698)	Maximum Lift Thickness (Loose) (inches)
Structural Fill	95	-3 to +3	8

6.3 Observations

Prior to structural fill placement, the CQC Engineer/technician will observe and document the condition of the base surface or surface of the previous lift. The CQC Engineer/technician will monitor the soils to confirm that the soils are free of deleterious materials and that they meet the project specification requirements. During structural fill placement, the CQC Engineer/technician will observe and document the lift thicknesses and the uniform mixing of soils.

6.4 Testing

Structural fill testing will consist of both in-place and laboratory testing described as follows.

6.4.1 Laboratory Testing (Conformance Testing)

For laboratory testing, The CQC Engineer/technician will obtain a bulk sample of the structural fill soils for conformance testing as described below. The CQC Engineer/technician may modify the number of bulk

samples needed for laboratory testing depending on the variability of the soils being placed. Laboratory testing will include, but not be limited, to the following tests.

Table – 6.2 Structural Fill Laboratory Conformance Testing Requirements

TEST	METHOD	MINIMUM FREQUENCY
Water (Moisture) Content	ASTM D2216	One (1) test per 5,000 cubic yards
Particle Size	ASTM D422	
Liquid Limit, Plastic Limit, and Plasticity Index	ASTM D4318	
Standard Proctor Compaction Characteristics	ASTM D698	

6.4.2 In-Place Testing (Performance Testing)

The CQC Engineer/technician will perform in-place field density and moisture content tests as shown in Table 4.3. Where multiple test methods are listed, only one test method need be used.

Table – 6.3 Structural Fill Performance Testing Frequency

TEST	METHOD	MINIMUM FREQUENCY
Field Density and Moisture Content	Sand Cone (ASTM D1556) OR Nuclear Gauge (ASTM D6938)	One (1) test per acre per lift
Confirmatory Field Density and Moisture Content for Nuclear Gauge Testing	Drive Cylinder (ASTM D2937)[1] Field Moisture (ASTM D2216)	One (1) per day

[1] Required when a nuclear gauge is used for testing

Required field density and moisture content tests will be completed before the overlying lift is placed.

If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it will be loosened by harrowing, or other means, before the succeeding layer is placed. When moisture content is too low, the moisture content will be adjusted to within the above limits prior to compaction. Moisture adjustment will be achieved by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and harrowing of the layer will be done after deposition, but before compaction. If the moisture content is too high, the CCR will be disked in place or stockpiled and disked to promote drying to bring it back within the allowable moisture range.

7. LOW PERMEABILITY SOIL LAYER FOR FINAL COVER SYSTEM

7.1 Material

The R6 CCR Landfill will be closed with a low-permeability compacted soil cover. The low permeability soil layer material will consist of cohesive soils capable of being place and compacted to meet the permeability criterion of k ≤1x10^{-5} cm/sec.

7.2 Pre-Construction Material Evaluation

7.2.1 All material to be used to construct the low-permeability soil layer will be sampled and tested by the CQC Engineer/technician, in advance of being placed, for conformance to the requirements listed in Table 5.2 and this Section. Such testing can be performed during excavation of the borrow area or from existing stockpiles.

7.2.2 The procedure for pre-construction testing of material to be used for low-permeability soil layer is outlined below:

A. Bulk samples shall be taken at a frequency of one sample per 5000 cubic yards, or change in soil type, per Table 5.2, for laboratory testing.

B. The following tests will be performed:

- Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM D2487
- Standard Test Method for Particle-Size Analysis of Soils, ASTM D422 (Mechanical Sieve Method Only).
- Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D2216.
- Test Method for Liquid Limit, and Plasticity Index of Soils, ASTM D4318.
- Standard Test Method for laboratory Compaction Characteristics of Soil Using Standard Effort, ASTM D698.
- Standard Test Methods for Measurement of Hydraulic Conductivity of Saturate Porous Materials Using a Flexible Wall Permeameter, ASTM D5084.

7.3 Construction

7.3.1 Only soil from a source previously sampled, tested and confirmed to meet the requirements of this CQA Plan will be used in construction of the low-permeability soil layer. The CQC Engineer/technician will notify the Contractor when material does not meet the requirements of this CQA Plan, and will document that this material is not used for low-permeability soil layer construction.

7.3.2 The CQC Engineer/technician will complete all required field density and moisture content tests before the overlying lift of low-permeability soil is placed.

7.3.3 The CQC Engineer/technician will observe and document that the Contractor completes all prior lift surface preparation (e.g., wetting, drying, scarification, etc.) before placement of subsequent lifts.

7.3.4 The CQC Engineer/technician will observe and document that loose lift thicknesses do not exceed 8 inches.

7.3.5 The CQC Engineer/technician will check each lift visually to ensure the fill is free of rocks and soil clods in excess of one (1) inch maximum dimension, debris, plant materials, and

other foreign material. The CQC Engineer/technician will inform the Contractor, if such materials are found, and will document their removal.

7.3.6 The CQC Engineer/technician will observe and document that the exposed surface of the low permeability soil layer is rolled with a smooth drum roller or equivalent at the end of each work day or when required to protect the compacted soil from adverse weather conditions.

7.3.7 The CQC Engineer/technician will observe and document that the exposed surface of the low permeability soil layer is reasonably free of rock, rock fragments, or loose materials.

7.3.8 Comparison of the Final As-built Low Permeability Soil Layer Contour Drawings to the Final As-built Subgrade Elevation Contour Drawings shall be performed to verify the lift thickness of the low permeability soil layer meets the required minimum thickness of 18 inches.

7.3.9 The review of the Final As-built Low Permeability Soil Layer Contour Drawings, or pertinent areas thereof, and verification that the layer thickness meets or exceeds the minimum of 18 inches shall be part of the Subgrade Acceptance for the surficial soil layer. Subsequent work shall not proceed until the Subgrade Acceptance Certificate and the Final As-built Low Permeability Soil Layer Contour Drawings (or pertinent areas thereof) have been reviewed, approved, and signed by the Contractor, CQC Inspector, CQA Engineer and the Purchaser's Representative.

7.3.10 The CQC Engineer/technician will inspect the low-permeability soil layer and certify that it is constructed in accordance with the approved permit, CQA Plan and approved plans.

7.4 Performance Testing

Construction Quality Assurance sampling and testing will meet the minimum requirements indicated in the Table below. The CQC Engineer/technician or his /her representative will randomly determine the location of each test. All holes will be patched with a mixture of low-permeability soil and sodium bentonite pellets hydrated and compacted in the holes.

Table 7.1 Low Permeability Soil Fill Placement Criteria

Item	Required % Compaction Standard Proctor (ASTM D698)	Required % of Optimum Moisture, Standard Proctor (ASTM D698)	Maximum Lift Thickness (Loose) (inches)
Compacted Low Permeability Soil Fill	95	+2 to +5	8

Table 7.2 Low Permeability Soil Conformance Testing Requirements

TEST	METHOD	MINIMUM FREQUENCY
Water (Moisture) Content	ASTM D2216	One (1) test per 5,000 cubic yards or change in material
Particle Size	ASTM D422	
Liquid Limit, Plastic Limit, and Plasticity Index	ASTM D4318	
Standard Proctor Compaction Characteristics	ASTM D698	
Permeability	ASTM D5084	

Table 7.3 Low Permeability Soil Performance Testing Frequency

TEST	METHOD	MINIMUM FREQUENCY
Field Density and Moisture Content	Sand Cone (ASTM D1556) OR Nuclear Gauge (ASTM D6938)	One (1) test per 10,000 sf
	Field Moisture (ASTM D2216)	
Field Density and Moisture Content	Drive Cylinder (ASTM D2937)[1] Field Moisture (ASTM D2216)[1]	One (1) per day
Hydraulic Conductivity	ASTM D5084	One test per 40,000 sf

[1] Required when a nuclear gauge is used for testing

If the density does not meet minimum requirements of the CQA Plan, recompaction of the failed area (minimum 100' x 100') will be performed and retested until the area meets or exceeds requirements outlined in the CQA Plan. If a permeability sample fails to meet the minimum hydraulic conductivity requirements outlined in the CQA Plan, the area of failing permeability (minimum 40,000 sf) will be reconstructed. Optionally, at least four (4) replicate samples will be obtained in the immediate vicinity of the failed test. Should the replicate samples confirm the failure of the low permeability soil layer to meet CQA Plan, the area of failure will be localized according to the results of the replicate samples and reconstructed in accordance with the CQA Plan. All areas of reconstruction will be retested as outlined in the plan.

8. GEOMEMBRANE, ENGINEERED TURF & SAND BALLAST – CLOSURETURF® COVER SYSTEM

8.1 Introduction

The Geomembrane HydroTurf™ Cover System and HydroBinder™ Ballast shall be used for final slope drainage channel protection only and is not a component of the final cover system. However, the CQA Consultant will perform conformance and destructive seam testing, and monitor the installation of geomembranes, as required by the CCR Permit and this CQA Plan. The testing will evaluate the conformance of the geomembrane panels and seams with the requirements of the CCR Permit. The testing

will be performed in accordance with the current versions of the ASTM and other applicable test procedures indicated in Tables 6.1 and 6.2. Additionally, the HydroTurf® system will be monitored and tested to verify that installation is performed in accordance with the Manufacturer's specifications in addition to the requirements of the CCR Permit and this CQA Plan. Georgia Power and the CQA Firm will be notified prior to installation of any geosynthetics material.

8.2 Manufacturing Plant Visit

At the request of the Owner, the CQA Consultant or the Owner's Representative will visit the plant of the geomembrane Manufacturer to verify that manufacturing quality control procedures are in conformance with the Construction Documents. If possible, such a visit will be performed prior to or during the manufacturing of the geomembrane rolls for the Project.

During the project-specific manufacturing plant visit, the CQA Consultant or Owner's Representative will:

- verify that the measurements of properties by the Manufacturer are properly documented and test methods used are acceptable;
- spot-inspect the rolls and verify that they are free of holes, blisters, or any sign of contamination by foreign matter;
- review packaging and transportation procedures to verify that these procedures are not damaging the geomembrane;
- verify that all rolls are properly labeled; and
- verify that extrusion rods and/or beads manufactured for the field seaming of the geomembrane are derived from the same base resin type as the geomembrane.

Upon completion of the manufacturing plant visit, a report describing the findings and observations will be completed by the CQA Consultant or Owner's Representative and be included as an attachment to the final CQA Certification Report.

8.3 Materials, Handling, and Storage

The CQA Consultant will monitor the materials, handling, and storage of the geomembrane on the Project Site. Upon delivery at the Site, the Contractor, Installer, and CQA Consultant will conduct an inspection of the rolls for defects and damage. This inspection will be conducted without unrolling the materials unless defects or damages are found or suspected in the rolled material. All rolls of geomembrane delivered to the site will be inspected for the following:

- The Geomembrane is wrapped in rolls with protective covering.
- The rolls are not damaged during unloading.
- Protect the Geomembrane from mud, soil, dirt, dust, debris, cutting, or impact forces.
- Each roll must be marked or tagged with proper, original, manufacturer - applied identification.
- Separate damaged rolls from undamaged rolls and store at locations designated by the Purchaser until proper disposition of material is determined by the Purchaser.
- The Purchaser will be the final authority regarding damage.

The CQA Consultant will also monitor that equipment used to handle the geomembrane on-site is adequate and does not pose any risk of damage to the geomembrane during handling.

8.4 Manufacturer QC (MQC) Testing and Conformance (CQA) Testing

8.4.1 Sampling Procedures

If possible and at the Purchaser's request the CQA Consultant will obtain representative geomembrane conformance samples from the Manufacturer at the specified frequency prior to delivery of the geomembrane rolls to the Site and forward them to the Geosynthetics CQA Laboratory for testing. Geomembrane conformance samples will be taken across the entire width of the roll and will not include the first 3 feet of material. Unless otherwise directed by the Design Engineer, samples will be 3 feet long by the roll width. The required minimum geomembrane conformance sampling frequencies are provided in Table 6.1. The CQA Consultant will mark the machine direction on the samples with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;
- project number;
- lot/batch number and roll number;
- conformance sample number; and
- CQA personnel identification.

8.4.2 Testing Procedures

Conformance testing of the geomembrane materials obtained from the Manufacturer will be conducted by the Geosynthetics CQA Laboratory to verify compliance with the CCR Permit, this CQA Plan, and the Manufacturer's list of minimum average roll values.

8.4.3 Test Results

All MQC and conformance test results will be reviewed, accepted, and reported by the CQA Consultant before deployment of the geomembrane. Any non-conformance of the material properties with the requirements of the CCR Permit will be reported to the Contractor and Construction Site Manager.

8.4.4 Conformance Test Failure

In the case of failing test results, the Contractor may request that another sample from the failing roll be retested by the Geosynthetics CQA Laboratory. If the retest fails or if the option to retest is not exercised, then two isolation conformance samples will be obtained by the CQA Consultant. These isolation samples will be taken from rolls, which have been determined by correlation with the Manufacturer's roll number, to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. All rolls that fall numerically between the passing roll numbers will be rejected.

The CQA Consultant will verify that the Contractor has replaced all rejected rolls. The CQA Consultant will document all actions taken in conjunction with geomembrane conformance failures.

8.5 Anchor Trenches

The CQA Consultant will monitor, verify, and document that the anchor trench has been constructed as shown in the CCR Permit and meets the minimum requirements of the CQA Plan as described below.

To confirm conformance with the CCR Permit, the CQC Engineer/technician will:

- monitor that the anchor trench is constructed with a slightly rounded corner where the geosynthetics enter the trench and is backfilled as soon as possible after all geosynthetics are installed;
- perform in-place moisture/density testing of the compacted anchor trench backfill by nuclear methods at a frequency of one per 250 linear feet of anchor trench, or more frequent if deemed necessary in the opinion of the CQA Consultant;
- observe that geosynthetic materials in the anchor trench are temporarily anchored with sand bags or other suitable methods approved by the CQA Consultant if the trench will remain open after the installation of geosynthetics;
- monitor that no loose soils are left to underlie the geosynthetics in the anchor trench and all temporary ballast (i.e., sandbags) and deleterious materials are removed from the anchor trench prior to backfilling; and
- monitor that backfilling of the anchor trench is performed using extreme care when the geomembrane is in its most contracted state to minimize wrinkling and stress concentrations.

8.6 Geomembrane Placement

CQA Consultant Responsibility During Placement

The CQA Consultant will monitor, verify, and document that geomembrane placement is conducted is accordance with the CCR Permit and that CQA activities are performed as described in the subsections below.

Field Panel Identification

A field panel is a piece of geomembrane larger than approximately 10 square feet (ft^2) that is to be seamed in the field, i.e., a field panel is a roll or a portion of roll to be seamed in the field. The CQA Consultant will verify that each field panel is given an "identification code" (number or letter-number) that will:

- be selected as simple and logical as possible;
- be substantially consistent with the as-built layout plan; and
- allow tracing of the Manufacturer's roll numbers to the field panel identification code.

The CQA Consultant will verify documentation showing the correspondence between roll numbers, factory panels, and field panel identification codes. The field panel identification code will be used for all CQA records.

Field Panel Placement

The CQA Consultant will monitor that field panels are installed substantially at the location indicated in the Installer's layout plan, as approved, or modified. The CQA Consultant will record the field panel identification code, Manufacturer's roll number, location, date of installation, time of installation, and dimensions of each field panel.

The CQA Consultant will monitor that geomembrane placement does not proceed:

- at an ambient temperature below 40°F or above 104°F unless authorized by the Design Engineer; or
- during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds.

The CQA Consultant will monitor that the above conditions are fulfilled and that the supporting soil has not been damaged by adverse weather conditions. The CQA Consultant will monitor geomembrane deployment for conformance with the CCR Permit, including that:

- the geomembrane is deployed under acceptable temperature and weather conditions;
- any equipment used does not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons, or other means;
- the prepared surface underlying the geomembrane has not deteriorated since previous acceptance and is still acceptable immediately prior to geomembrane placement;
- any geosynthetic elements immediately underlying the geomembrane are clean and free of foreign objects or debris;
- all personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane;
- the method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting subbase;
- the method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);
- adequate temporary loading and/or anchoring (e.g., sand bags, tires), not likely to damage the geomembrane, has been placed to prevent uplift by wind; and
- direct contact with the geomembrane is minimized; i.e., the geomembrane is protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected.

The CQA Consultant will observe the geomembrane panels, after placement and prior to seaming, for damage. The CQA Consultant will advise the Construction Manager of any panels, or portions of panels, that should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected will be marked and their removal from the work area recorded by the CQA Consultant. CQA for geomembrane repairs will be in accordance with the CQA Plan.

8.7 Field Panel Seaming

8.7.1 CQA Consultant Responsibility During Seaming

The CQA Consultant will monitor, verify, and document that geomembrane panel layout and field panel seaming is conducted in accordance with the CCR Permit and that CQA activities are performed as described in the subsections below.

8.7.2 Panel Layout

The CQA Consultant will review the panel layout drawing previously submitted to the Construction Manager by the Installer and verify that:

- seams are generally oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope;
- the number of seams is minimized in corners and odd-shaped geometric locations;
- a seam numbering system is used that is compatible with the field panel identification numbering system and is agreed upon by the CQA Consultant and the Installer prior to any seaming; and
- the panel layout is consistent with accepted state of practice.

8.7.3 Seaming Equipment and Products

The CQA Consultant will verify that only extrusion welding and fusion welding are used for field seaming. The CQA Consultant will document that any alternate process proposed by the Installer is reviewed and approved by the Design Engineer and Construction Manager.

The CQA Consultant will verify that no geomembrane seaming is performed unless the CQA Consultant is on-site. The CQA Consultant will monitor the general seaming procedure used as follows:

- the Installer uses of seaming equipment specifically recommended by the Geosynthetics Manufacturer by make and model, and marked with an identification number;
- the Installer uses of a firm substrate such as a flat board, a conveyor belt, or similar hard surface directly under the seam overlap, if required, to achieve proper support;
- the Installer cuts fishmouths or wrinkles at the seam overlaps along the ridge of the wrinkle in order to achieve a flat overlap;
- the Installer cuts fishmouths or wrinkles, and patches any portion, where the overlap is inadequate, with an oval or round patch of the same geomembrane extending a minimum of 6-inches beyond the cut in all directions;
- the Installer/Contractor provides adequate illumination if seaming operations are carried out at night, and
- the Installer extends seaming to the outside edge of panels to be placed in the anchor trench.

8.7.4 Fusion Process

The CQA Consultant will monitor ambient temperatures, geomembrane surface temperatures, apparatus speed, and apparatus temperatures at appropriate intervals.

The CQA Consultant will also monitor that:

- the fusion-welding apparatus is an automated, self-propelled device;
- the fusion-welding apparatus is equipped with gauges giving the applicable temperatures and welding speed;
- the number of spare operable seaming apparatus agreed by the Construction Manager are maintained on-site;
- equipment used for seaming will not damage the geomembrane;
- the seaming zone is dry and clean;
- there is sufficient overlap between panels;
- the electric generator is placed on a smooth base such that no damage occurs to the geomembrane;
- for cross seams, the edge of the cross seam is cut or ground to a smooth incline (top and bottom) prior to welding;
- an insulating material is placed beneath the hot welding apparatus after usage; and
- a movable protective layer is used, as necessary, directly below each overlap of geomembrane that is to be seamed to prevent build-up of moisture between the sheets.

8.7.5 Extrusion Process

The CQA Consultant will verify that the extrudate is comprised of the same resin as the geomembrane sheeting. The CQA Consultant will monitor extrudate temperatures, ambient temperatures, and geomembrane surface temperatures at appropriate intervals to document that they conform to the CCR Permit.

The CQA Consultant will also monitor that:

- the extrusion-welding apparatus is equipped with gauges giving the temperature in the apparatus and at the nozzle;
- the number of spare operable seaming apparatus agreed by the Construction Manager are maintained on-site;
- equipment used for seaming is not likely to damage the geomembrane;
- the seaming zone is dry and clean;
-
- the extruder is purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel;
- the electric generator is placed on a smooth base such that no damage occurs to the geomembrane; and
- an insulating material is placed beneath the hot welding apparatus after usage.

8.7.6 Seam Preparation

To confirm conformance with the CCR Permit, the CQA Consultant will monitor that:

- prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material;
- seams are overlapped in accordance with the requirements of the CCR Permit;

- if seam overlap grinding is required, the process is completed according to the Geosynthetics Manufacturer's instructions or the CCR Permit, whichever is the more stringent, prior to the seaming operation, and in a way that does not damage the geomembrane;
- the grind depth is constructed in accordance with the requirements of the CCR Permit;
- grinding marks do not appear beyond the extrudate after it is placed; and
- seams are aligned with the fewest possible number of wrinkles and fishmouths.

8.7.7 Weather Conditions for Seaming

The CQA Consultant will monitor that the weather conditions for seaming are within the acceptable range, as follows:

- the ambient temperature is not below 40°F or above 104°F, unless authorized by the Design Engineer;
- geomembrane is preheated by either sun or hot air device between ambient temperatures of 40°F and 50°F prior to performing seaming; and
- geomembrane seam areas are dry and protected from rain and wind.

The CQA Consultant will verify that methods used by the Installer for seaming at ambient temperatures below 40°F or above 104°F will produce seams that are entirely equivalent to seams produced at ambient temperatures between 40°F and 104°F and will protect the overall quality of the geomembrane. The CQA Consultant will monitor that seaming conducted during abnormal weather conditions is performed in accordance with the methods approved by the Design Engineer.

8.7.8 Overlapping and Temporary Bonding

The CQA Consultant will monitor that:

- the panels of geomembrane have a finished overlap of a minimum of 4 inches for both extrusion and fusion welding, but in any event sufficient overlap is provided to allow peel tests to be performed on the seam;
- no solvent or adhesive is used; and
- the procedure used to temporarily bond adjacent panels together does not damage the geomembrane. In particular, the temperature of hot air at the nozzle of any spot welding apparatus is controlled such that the geomembrane is not damaged.

8.7.9 Trial Seams

The CQA Consultant will verify that the Installer performs trial seam tests in accordance with the CCR Permit. The CQA Consultant will observe and document the Installer’s trial seam testing procedures. The trial seam samples will be assigned an identification number and marked accordingly by the CQA Consultant. Each sample will be marked with the date, time, machine temperature(s) and setting(s), number of seaming unit, and name of seaming technician. Trial seam samples will be maintained until destructive seam testing of the applicable seams are tested and pass.

8.7.10 Nondestructive Seam Continuity Testing

The CQA Consultant will monitor that the Installer nondestructively tests all field seams over their full length using a vacuum test unit or air pressure test (for double fusion seams only). The CQA Consultant will monitor that the Installer performs spark testing if the seam cannot be tested using the vacuum or air pressure test methods. The purpose of nondestructive tests is to check the continuity of seams. The CQA Consultant will monitor that the Installer performs continuity testing as the seaming work progresses, not at the completion of all field seaming. The CQA Consultant will:

- monitor nondestructive testing;
- document the results of the nondestructive testing; and
- inform the Contractor and Construction Manager of any noncompliance.

The CQA Consultant will monitor that the Installer performs any required seam repairs in accordance with the CCR Permit. The CQA Consultant will:

- observe the repair procedures;
- observe the re-testing procedures; and
- document the results.

The seam number, date of observation, dimensions and/or descriptive location of the seam length tested, name of person performing the test, and outcome of the test will be recorded by the CQA Consultant.

8.7.11 Destructive Testing and CQA Performance Testing Requirements

The CQA Consultant will monitor the Installer performing destructive seam field testing during the geomembrane installation. The purpose of this testing is to evaluate seam strength. The CQA Consultant will monitor that the Installer performs destructive seam testing as the seaming work progresses, not at the completion of all field seaming.

The CQA Consultant will also conduct laboratory destructive seam testing as required by this CQA Plan. The testing will be performed in accordance with the current versions of the ASTM and other applicable test procedures and at the minimum frequencies presented in Table 6.1

The CQA Consultant will review the destructive seam test results to verify that the requirements of the CCR Permit and this CQA Plan are met. The CQA Consultant may conduct additional destructive seam testing if deemed necessary by the Owner and/or CQA Certifying Engineer. Such additional testing may only be performed after the CQA Consultant submits, and the Owner approves, a written request that describes the reason(s) for additional testing.

8.7.12 Location and Frequency

The CQA Consultant will select all destructive seam test sample locations. Sample locations will be established as follows.

- Destructive testing will be performed at a minimum frequency of one test location per 500

feet of seam length. This minimum frequency is to be determined as an average taken throughout the entire installation. This minimum frequency may be increased for seams made outside the normal ambient temperature range of 40°F to 104°F.

- Test locations will be determined during seaming at the CQA Consultant's discretion.

Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of imperfect welding.

The Installer will not be informed in advance of the locations where the seam samples will be taken.

8.7.13 Sampling Procedures

Destructive seam testing will be performed by the Geosynthetics CQA Laboratory as seaming progresses in order to obtain test results prior to the geomembrane being covered by overlying materials. The CQA Consultant will:

- observe sample cutting;
- assign a number to each sample, and mark it accordingly; and
- record sample location on geomembrane panel layout drawing.

The CQA Consultant will monitor that the Installer performs repairs to all holes in the geomembrane resulting from destructive seam test sampling in accordance with repair procedures described in the CCR Permit. In addition, the CQA Consultant will monitor that the Installer performs non-destructive testing as described in this Section to ensure the continuity of the new seams.

8.7.14 Size of Samples

The CQA Consultant will monitor that at a given sampling location, two types of samples (field test samples and laboratory test samples) are taken:

- First, a minimum of two field samples or test strips are taken for field testing. Each of these test strips are approximately 1 inch wide by 12-inches long, with the seam centered parallel to the width. The distance between these two specimens is approximately 42-inches. If both specimens pass the field test described in this Section, a second full laboratory destructive sample is taken for testing by the Geosynthetics CQA Laboratory.
- The full destructive sample is located between the two field test strips. The sample is approximately 12-inches wide by 42-inches long with the seam centered lengthwise. The sample is cut into three parts and distributed as follows:
- one approximately 12-inches by 12-inches portion to the Installer;
- one approximately 12-inches by 12 inches portion to the Construction Manager for archive storage; and
- one approximately 12-inches by 18-inches portion for Geosynthetics CQA Laboratory testing.

8.7.15 Field Testing

The CQA Consultant will monitor that the test strips are tested in the field, for peel adhesion, using a gauged tensiometer by the Installer. In addition to meeting the strength requirements outlined in Table 6.1, the CQA Consultant will monitor that all specimens exhibit a film tear bond and do not fail in the weld. If any field test sample fails to meet these requirements, the destructive sample has failed.

The CQA Consultant will witness all field tests and mark all samples and portions with their number. The CQA Consultant will also log the date, number of seaming unit, seaming technician identification, destructive sampling, and pass or fail description.

8.7.16 Geosynthetics CQA Laboratory Testing

Destructive test samples will be tested by the Geosynthetics CQA Laboratory. Testing will include "Bonded Seam Strength" and "Peel Adhesion". The minimum acceptable values to be obtained in these tests are presented in Table 6.1. At least five specimens will be tested for each test method (i.e., five for peel and five for shear). Specimens will be selected alternately by test from the samples (i.e., peel, shear, peel, shear, etc.). Both the inside and outside tracks of the double track fusion seams will be tested for peel adhesion. A passing test will meet the minimum required values in Table 6.1.

The Geosynthetics CQA Laboratory will provide test results no more than 24 hours after they receive the samples. The CQA Consultant will review laboratory test results as soon as they become available and report the results to the Construction Manager.

8.7.17 Procedures for Destructive Test Failure

The CQA Consultant will monitor that the following procedures apply whenever a sample fails a destructive test, whether that test was conducted in the field or by the Geosynthetics CQA Laboratory. The CQA Consultant will monitor that the Installer follows one of the two options below:

- The Installer can reconstruct the seam (e.g., remove the old seam and re-seam) between any two passed destructive test locations or between points judged by the CQA Consultant to represent conditions of the failed seam (e.g., a tie-in seam or a seam made by the apparatus and/or operator used in the failing seam); or
- The Installer can trace the welding path to an intermediate location a minimum of 10 feet from the point of the failed test in each direction and take a small sample for additional field testing in accordance with the destructive test procedure at each location. If these additional isolation samples pass the field test, then full laboratory samples are taken at both locations. If these laboratory samples meet the specified strength criteria, then the seam is reconstructed between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed or repaired.

The CQA Consultant will monitor that all failed seams are bound by two locations from which samples passing laboratory destructive tests have been taken or the entire seam is reconstructed and re-tested. In cases exceeding 150 feet of reconstructed seam, a sample will be taken from the reconstructed portion of the seam and must pass destructive testing. The CQA Consultant will observe that any repairs are

made in accordance with Section 7.7. The CQA Consultant will document all actions taken in conjunction with destructive test failures.

8.8 Defects and Repairs

8.8.1 CQA Consultant Responsibility for Monitoring Defects and Repairs

The CQA Consultant will monitor, verify, and document that geomembrane defects are addressed and repairs are made in accordance with the CCR Permit and that CQA activities are performed as described below.

8.8.2 Identification

All seams and non-seam areas of the geomembrane will be examined by the CQA Consultant for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be clean at the time of examination. The CQA Consultant will request that the Contractor broom or wash the geomembrane surface if the amount of dust or mud inhibits examination.

8.8.3 Repair Procedures

The CQA Consultant will monitor that any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, is repaired by the Installer in accordance with the CCR Permit. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure, materials, and equipment will be agreed upon between the Installer and CQA Consultant. In addition, the following conditions will be monitored by the CQA Consultant:

- surfaces of the geomembrane which are to be repaired are abraded no more than one hour prior to the repair;
- all surfaces are clean and dry at the time of the repair;
- patches or caps extend at least 6-inches beyond the edge of the defect, and all corners of patches are rounded with a radius of at least 3-inches; and
- the geomembrane below large caps is appropriately cut to avoid water between the two sheets.

8.8.4 Verification of Repairs

Each repair will be numbered and logged by the CQA Consultant. The CQA Consultant will monitor that each repair is non-destructively tested by the Installer using approved methods. Repairs which pass the non-destructive test will be taken as an indication of an adequate repair. Large caps may be of sufficient extent to require destructive test sampling, at the discretion of the CQA Consultant or as specified in Table 6.1. The CQA Consultant will observe all non- destructive testing of repairs and will record the number of each repair, date, and test outcome.

8.9 Geomembrane and Cap System Acceptance

In accordance with the CCR Permit, the Contractor retains all responsibility for the geosynthetics until acceptance by the Construction Manager. The terms and conditions for the geomembrane and cover system acceptance are described in the CCR Permit.Materials in Contact with the Geomembrane

The procedures outlined in this section are intended to allow the CQA Consultant to verify that the installation of materials in contact with the geomembrane do not cause damage to it.

8.10.1 Material and Engineered Turf

The CQA Consultant will monitor that the Contractor conforms with the requirements of the CCR Permit and takes all necessary precautions to verify that the geomembrane is not damaged during its installation, during the installation of other components of the final cover systems, or by other construction activities. The CQA Consultant will monitor the following:

- placement of materials above the geomembrane are not placed at an ambient temperature below 40°F or above 104°F unless otherwise approved by the Design Engineer and Construction Site Manager;
- material placement operations above the geomembrane are performed by the Contractor to minimize wrinkles in the geomembrane;
- equipment used for placing material are not driven directly on the geomembrane or other geosynthetic layers;

8.10.2 Appurtenances

The CQA Consultant will monitor that:

- installation of the geomembrane in appurtenant areas and connection of geomembrane to appurtenances (e.g., concrete pads or concrete embedment strips at geomembrane termination) are made in accordance with the CCR Permit;
- extreme care is given by the Installer when seaming around appurtenances since neither non-destructive nor destructive testing may be feasible in these areas; and
- the geomembrane is not visibly damaged when making connections to appurtenances.

GEOMEMBRANE
CONFORMANCE TESTING

TABLE 8.1

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY
Density	ASTM D 1505 OR ASTM D 792	NOTE 1
Thickness	ASTM D 5994	
Tensile Strength at Yield	ASTM D 6693, Type IV	
Tensile Strength at Break		
Elongation at Yield		
Elongation at Break		
Carbon Black Content	ASTM D 1603 or ASTM D 4218	

Notes:

1. The minimum number of rolls to be sampled for each shipment will be determined by computing the cube root of the total number of rolls delivered in the shipment, and rounding this value upward to the nearest integer, with at least one sample per each manufacture's lot, For instance, if 40 rolls of geomembrane are delivered in a shipment at least four rolls will be sampled. Testing should be performed at a minimum frequency of one per lot or as described above, whichever is more frequent.

MANUFACTURER QUALITY CONTROL REQUIREMENTS
50-MIL HDPE GEOMEMBRANE

TABLE 8.2			
Property	Frequency	Test Method	Minimum Average Value
Raw Materials: Density Melt Index	 Once per 200,000 lbs of resin Once per 200,000 lbs resin	 ASTM D 1505 ASTM D 792 ASTM D 1238,190˚C, 2.16kg	 Min. 0.932 g/cc ≤ 1.0 g/10 min.
Thickness Minimum Average Lowest individual of 8 of 10 readings	per roll	ASTM D 5994	 50 mils 45 mils
Drainage Stud Height (min. avg)	Every Second Roll	ASTM D7466[2]	130 mil
Asperity Height (min. avg)	Every Second Roll	ASTM D7466[2]	20 mil
Density	Once per 200,000 lbs of resin	ASTM D 792B	Min. 0.94 g/cc
Tensile Properties (avg. both directions) (min. avg) Break Strength Break Elongation	20,000 lbs.	ASTM D 6693, Type IV 2 in/min	 110 lb/in 300 %
Tear Resistance	45,000 lbs	ASTM D 1004	38 lb (min. avg.)
Puncture Resistance	45,000 lbs	ASTM D 4833	80 lb (min. avg.)
Carbon Black Content	20,000 lbs.	ASTM D 4218	2.0 % - 3.0 %
Carbon Black Dispersion	45,000 lbs.	ASTM D 5596	Note (3)
Oxidative Induction Time (OIT) Standard OIT, minutes	200,000 lbs	ASTM D 3895, 200˚C, 1 atm 0_2	 140 (min. avg.)
Oven Aging @ 85ºC High Pressure OIT (min. avg.) - % retained after 90 days	Per Each Formulation	ASTM D5721 ASTM D5885, 150˚C, 500psi 0_2	 80%
UV Resistance High Pressure OIT - % retained after 1600 hours	Per Each Formulation	ASTM D7238 ASTM D5885, 150˚C, 500psi 0_2	(20hr. cycle @ 75˚C/4hr. condensation @60˚) 50%

1. Reference GRI GM13, HDPE MicroDrain Liner Product Data Sheet, Agru America.
2. Even though ASTM D7466 is specific to textured geomembrane, this method is still applicable for MicroDrain materials.
3. Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.

TABLE 8.3 - ENGINEERED TURF COMPONENT					
Property	**Frequency**	**Test Method**	**(CT Product) Minimum Average Value**	**(CTX Product) Minimum Average Value**	**(CTHD Product) Minimum Average Value**
Yarn Type	N/A	N/A	Polyethylene, Fibrillated	Polyethylene, Fibrillated/Monofilament Blend	Polyethylene, Fibrillated
Yarn Color	N/A	N/A	Olive Green, Play Green, Tan (Owner to designate color)	Green, Tan Blend (Owner to designate color)	Olive Green (Owner to designate color)
Yarn Weight (Total product weight)	Once per 300,000 sf	ASTM D5261 (sample size, 1 yd[2)]	≥20 oz/sq.yd. (32 oz/sq.yd ± 2 oz)	≥22 oz/sq.yd. (34 oz/sq.yd ± 2 oz)	≥31 oz/sq.yd. (40 oz/sq.yd ± 2 oz)
Tensile Strength of Yarn	Once per 300,000 sf	ASTM D2256	15 lbs min.	15 lbs min.	15 lbs min.
CBR Puncture	Once per 300,000 sf	ASTM D6241	1,500 lbs (MARV)	1,500 lbs (MARV)	1,500 lbs (MARV)
Tensile Product (MD/XD)	Once per 300,000 sf	ASTM D4595	2,100 MD/1,600 XD lb/ft min. (MARV)	2,100 MD/1,600 XD lb/ft min. (MARV)	2,100 MD/1,600 XD lb/ft min. (MARV)
Rainfall Induced Erosion	N/A	ASTM D6459	Infill Loss <0.1% at 6 in/hr rainfall	Infill Loss <0.1% at 6 in/hr rainfall	Infill Loss <0.1% at 6 in/hr rainfall
Aerodynamic Evaluation	N/A	GTRI Wind Tunnel	120 mph with max. uplift of 0.12 psf	120 mph with max. uplift of 0.12 psf	120 mph with max. uplift of 0.12 psf
Turf Fiber UV Stability	N/A	ASTM G147	>60% retained tensile strength @ 100 yrs (projected)	>60% retained tensile strength @ 100 yrs (projected)	>60% retained tensile strength @ 100 yrs (projected)
Backing system UV Stability (Exposed)	N/A	ASTM G154 Modified Cycle 1, UVA340	110 lb/ft retained tensile strength @ 6,500 hrs (projected)	110 lb/ft retained tensile strength @ 6,500 hrs (projected)	110 lb/ft retained tensile strength @ 6,500 hrs (projected)
Steady State Hydraulic Overtopping (ClosureTurf® with HydroBinder™)	N/A	ASTM D7277 ASTM D7276	5 ft overtopping resulting in 29 fps velocity & 8.8 psf shear stress for Manning N Value of 0.02	5 ft overtopping resulting in 29 fps velocity & 8.8 psf shear stress for Manning N Value of 0.02	5 ft overtopping resulting in 29 fps velocity & 8.8 psf shear stress for Manning N Value of 0.02
Full Scale Wave Overtopping Test – Cumulative Volume (ClosureTurf® with HydroBinder™)	N/A	CSU Wave Simulator	165,000 ft^3/ft	165,000 ft^3/ft	165,000 ft^3/ft
Full Scale Wave Overtopping Test – Max. Avg. Wave Overtopping Discharge (ClosureTurf® w/ HydroBinderTM)	N/A	CSU Wave Simulator	4.0 $ft^3/s/ft$	4.0 $ft^3/s/ft$	4.0 $ft^3/s/ft$

Transmissivity w/ underlying structured geomembrane, Normal Stress @ 50 psf & 0.33m^2/sec gradient	NA	ASTM D4716	2.5 x 10^{-3} m^2/sec, min.	2.5 x 10^{-3} m^2/sec, min.	2.5 x 10^{-3} m^2/sec, min.
Internal Friction of combined components	N/A	ASTM D5321	33˚, min. peak	34˚, min. peak	33˚, min. peak

TABLE 8.4 - ENGINEERED TURF INFILL & BALLAST SAND	
ASTM C136	
Sieve	Percent Passing
3/8 in. (9.5mm)	100
No. 4 (4.75 mm)	90 – 100
No. 8 (2.36 mm)	50 – 85
No. 16 (1.18 mm)	25 – 65
No. 30 (600 µm)	10 – 45
No. 50 (300 µm)	0 – 30
No. 100 (150 µm)	0 - 10
No. 200 (750 µm)	0 - 5
ADDITIONAL REQUIREMENTS	
Fine aggregate angularity shall be tested in accordance with ASTM C 1252/AASHTO T 304, Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading). Method A. Method A uncompacted void content shall be greater than or equal to 40%.	
Sand infill specific gravity shall be tested in accordance with ASTM C 128/AASHTO T 84, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate. Bulk oven-dry specific gravity shall be greater than or equal to 2.40.	

TABLE 8.5 – ENGINEERED TURF HydroBinder™ INFILL & BALLAST	
Product	80 lb. bags or 3000 lb. bulk super sacks
Cement	Portland Cement Brand meeting ASTM C150, Type I or II. Only one brand used throughout project.
Cementitious Infill Mix	ASTM C387 for high strength mortars. Min. 28 day compressive strength of 5000 psi for the batched material as supplied

9. GENERAL SITE WORK

9.1 Introduction

The CQA Firm and the CQC Engineer/technician will monitor the activities that are to be performed for various general site work items including, but not limited to installation of riprap, erosion and sediment control measures, culverts, outfall weirs, pipes, vegetative cover, topsoil, and vegetation for compliance with the Design Documents.

9.2 Conformance

Conformance of materials and construction techniques to verify compliance with the Design Documents will be performed by the CQC Engineer/technician. If non-conformances or other deficiencies are found by the CQC Engineer/technician in the materials or completed work, they will be reported to the Contractor and Construction Site Manager. The CQC Engineer/technician will observe the repairs or replacements of any non-compliant items.

10. CERTIFICATION

The installation of the final cover system for the closed areas will be certified by the CQA Engineer as being performed in accordance with the Georgia Environmental Protection Division's State CCR Rule 391-3-4-.10. This certification and closure construction report will be prepared by a professional engineer registered in the State of Georgia and submitted to GA EPD.